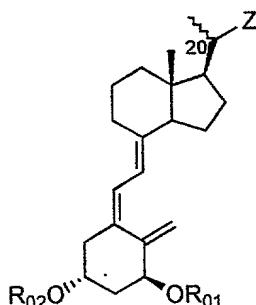


CLAIMS

1. A vitamin D<sub>3</sub> derivative expressed by the following general formula (1) or pharmaceutically permissible solvates thereof,

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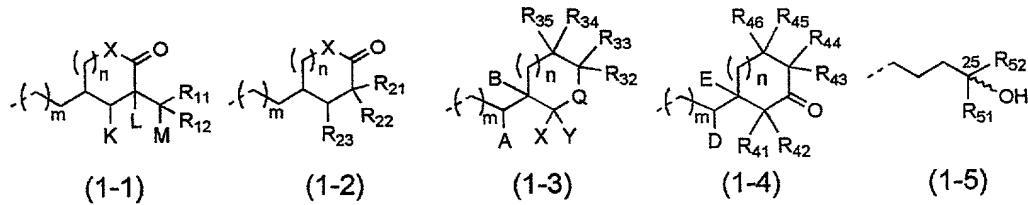


(1)

{wherein, R<sub>01</sub> and R<sub>02</sub> are each independently a hydrogen atom, a trimethylsilyl group, a triethylsilyl group, a t-butyldimethylsilyl group, an acetyl group, a methoxymethyl group or a tetrahydro-4H-pyran-2-yl group;

10

Z is one out of the following formulae (1-1), (1-2), (1-3), (1-4) or (1-5),



[in the above formulae (1-1) to (1-5),

15

m is an integer of 0 to 2;

n is an integer of 0 to 2;

X is an oxygen atom or NH;

R<sub>11</sub> and R<sub>12</sub> are identical to or different from each other, and express a hydrogen atom or a C<sub>1</sub>-C<sub>4</sub> alkyl group;

20

K, L and M take each a hydrogen atom; M is a hydrogen atom, and K and L together express a single bond and express a double bond in cooperation with the single bond already shown in the formula; or K is a hydrogen atom, and L and M together express a single bond and express a

double bond in cooperation with the single bond already shown in the formula;

5        R<sub>21</sub>, R<sub>22</sub> and R<sub>23</sub> are identical to or different from each other, and they are a hydrogen atom, a hydroxy group, a carboxyl group, a trifluoromethyl group, a pentafluoroethyl group, a C<sub>1</sub>-C<sub>4</sub> alkyloxycarbonyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group, or R<sub>21</sub> and R<sub>22</sub> together may express a C<sub>3</sub>-C<sub>6</sub> cyclic alkyl group in cooperation with the carbon atom to which they are bonded;

10      Q expresses >C(-F)-R<sub>31</sub> or >N-R<sub>31</sub>, and herein R<sub>31</sub> is a hydrogen atom, a hydroxyl group, a trifluoromethyl group, a pentafluoroethyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group;

15      R<sub>32</sub>, R<sub>33</sub>, R<sub>34</sub> and R<sub>35</sub> are identical to or different from each other, and they are a hydrogen atom, a hydroxyl group, a C<sub>1</sub>-C<sub>4</sub> alkyl group or a C<sub>2</sub>-C<sub>5</sub> acyloxy group;

20      A and B are identical to or different from each other, and they express a hydrogen atom or a hydroxyl group, or together express a single bond and form a double bond in cooperation with the single bond already shown in the formula;

25      X and Y together express a carbonyl group in cooperation with the carbon atom to which they are bonded, one of them is a hydrogen atom and the other is a hydroxyl group, or one of them is a hydrogen atom and the other is a C<sub>2</sub>-C<sub>5</sub> acyloxy group;

30      R<sub>41</sub> and R<sub>42</sub> are identical to or different from each other, and they express a hydrogen atom, a hydroxyl group, a trifluoromethyl group, a pentafluoroethyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group, or both the members together express a C<sub>1</sub>-C<sub>5</sub> alkylidene group, or they express a C<sub>3</sub>-C<sub>6</sub> cyclic alkyl group in cooperation with the carbon atom to which they are bonded;

35      R<sub>43</sub> and R<sub>44</sub> are identical to or different from each other, and they express a hydrogen atom, a hydroxyl group, a trifluoromethyl group, a

5 pentafluoroethyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group, or both the members together express a C<sub>1</sub>-C<sub>5</sub> alkylidene group, or express a C<sub>3</sub>-C<sub>6</sub> cyclic alkyl group in cooperation with the carbon atom to which they are bonded;

10 R<sub>45</sub> and R<sub>46</sub> are identical to or different from each other, and they express a hydrogen atom, a hydroxyl group, a trifluoromethyl group, a pentafluoroethyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group;

15 D and E express each a hydrogen atom, D is a hydroxy group and E expresses a hydrogen atom; D and E together express a single bond and express a double bond in cooperation with the single bond already shown in the formula, or E and R<sub>41</sub> together express a single bond and express a double bond in cooperation with the single bond already shown in the formula, wherein D expresses a hydrogen atom or a hydroxy group; and R<sub>42</sub> expresses a hydrogen atom, a hydroxyl group, a trifluoromethyl group, a pentafluoroethyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group, a C<sub>1</sub>-C<sub>4</sub> alkyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxyl group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group;

20 R<sub>51</sub> expresses -CONR<sub>511</sub>R<sub>512</sub>, -COR<sub>513</sub> or -C(OH)R<sub>514</sub>R<sub>515</sub>, wherein R<sub>511</sub> and R<sub>512</sub> are identical to or different from each other, and they are a hydrogen atom or a C<sub>1</sub>-C<sub>4</sub> alkyl group, or both the members together express a nitrogen-containing C<sub>3</sub>-C<sub>8</sub> alkyl ring or a morpholino group in cooperation 25 with the nitrogen atom to which they are bonded; and R<sub>513</sub>, R<sub>514</sub> and R<sub>515</sub> are identical to or different from each other, and they express a C<sub>1</sub>-C<sub>4</sub> alkyl group;

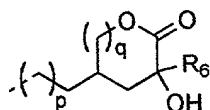
25 R<sub>52</sub> expresses a methyl group, an ethyl group, a trifluoromethyl group or a pentafluoroethyl group,

30 with the proviso that the following compounds (a), (b) and (c) are excluded,

(a) a compound in which the groups of one combination out of R<sub>21</sub> and R<sub>22</sub>, R<sub>32</sub> and R<sub>33</sub>, R<sub>34</sub> and R<sub>35</sub>, R<sub>41</sub> and R<sub>42</sub>, R<sub>43</sub> and R<sub>44</sub>, and R<sub>45</sub> and R<sub>46</sub> are both hydroxy groups, both alkyloxy groups, or a hydroxy group and an

alkyloxy group,

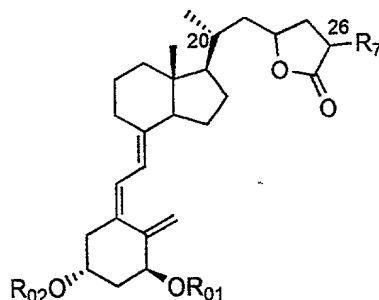
(b) a compound expressed by the above formula (1) in which Z is the following formula (1-6),



(1-6)

5 (wherein,  $p$  and  $q$  are each 0 or the integer 1;  $R_6$  is a hydrogen atom or a  $C_1\text{-}C_4$  alkyl group), and

(c) a compound of the following formula (2),



(2)

10 (wherein,  $R_{01}$  and  $R_{02}$  are defined in the same manner as in the above formula (1); the configuration of the carbon atom at the 20-position is (R)-configuration;  $R_7$  is a methyl group or a methylene group; when  $R_7$  is a methylene group, the bond between  $R_7$  and the carbon atom at the 26-position is double bond).

15 2. A vitamin  $D_3$  derivative or a pharmaceutically permissible solvate thereof described in Claim 1, wherein, in the above formula (1), Z is one out of (1-2), (1-3), (1-4) and (1-5).

20 3. A vitamin  $D_3$  derivative or a pharmaceutically permissible solvate thereof described in Claim 1, wherein, in the above formula (1), Z is (1-1).

4. A vitamin  $D_3$  derivative or a pharmaceutically permissible solvate thereof described in Claim 1, wherein, in the above formula (1), Z is (1-2).

5. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 1, wherein, in the above formula (1), Z is (1-3).

6. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible  
5 solvate thereof described in Claim 1, wherein, in the above formula (1), Z is (1-4).

7. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 1, wherein, in the above formula (1), Z is (1-5).

10 8. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in one out of Claims 1 to 7, wherein, in the above formula (1), R<sub>01</sub> and R<sub>02</sub> are both hydrogen atoms.

15 9. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in one out of Claims 1 to 6, wherein, in the above formula (1), m is 0 or 1.

10. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in one out of Claims 1 to 6, wherein, in the above formula (1), n is 0 or 1.

20 11. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 3 or 4, wherein, in the above formula (1), X' is an oxygen atom.

25 12. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 3, wherein, in the above formula (1), R<sub>11</sub> and R<sub>12</sub> are identical to or different from each other, and they are a hydrogen atom, a methyl group or an ethyl group.

30 13. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 3, wherein, in the above formula (1), K is a hydrogen atom, and L and M together express a single bond and express a double bond in cooperation with the single bond already shown in the formula.

14. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 4, wherein, in the above formula (1), R<sub>21</sub> and R<sub>22</sub> are identical to or different from each other, and they are a hydrogen atom, a hydroxy group or a C<sub>1</sub>-C<sub>4</sub> alkyl group, or R<sub>21</sub> and R<sub>22</sub> together express

a C<sub>3</sub>-C<sub>6</sub> cyclic alkyl group in cooperation with the carbon atom to which they are bonded.

15. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 4, wherein, in the above formula (1), R<sub>23</sub> is 5 a hydrogen atom or a hydroxyl group.

16. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 4, wherein, in the above formula (1), the combination of R<sub>21</sub>, R<sub>22</sub> and R<sub>23</sub> is one out of

- (a) R<sub>21</sub>, R<sub>22</sub> and R<sub>23</sub> are all hydrogen atoms,
- 10 (b) R<sub>21</sub> and R<sub>22</sub> are methyl groups, and R<sub>23</sub> is a hydrogen atom,
- (c) the combination of R<sub>21</sub> and R<sub>22</sub> is a methyl group and a hydroxyl group, and R<sub>23</sub> is a hydrogen atom,
- (d) the combination of R<sub>21</sub> and R<sub>22</sub> is a methyl group and a hydroxyl group, and R<sub>23</sub> is a hydroxyl group and
- 15 (e) R<sub>21</sub> and R<sub>22</sub> together form a cyclopropyl group in cooperation with the carbon atom to which they are bonded, and R<sub>23</sub> is a hydrogen atom.

17. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), Q is >C(-F)-R<sub>31</sub>.

20. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), Q is >N-R<sub>31</sub>.

25. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), R<sub>31</sub> is a hydrogen atom, a hydroxyl group or a C<sub>1</sub>-C<sub>4</sub> alkyl group which may be substituted with a hydroxy group, a C<sub>2</sub>-C<sub>5</sub> acyloxy group or a C<sub>1</sub>-C<sub>4</sub> alkyloxy group.

30. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), R<sub>32</sub>, R<sub>33</sub>, R<sub>34</sub> and R<sub>35</sub> are each a hydrogen atom.

21. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), A and B are both hydrogen atoms, A is a hydroxyl group and B is a hydrogen atom, or A and B together express a single bond and form a double bond in

cooperation with the single bond already shown in the formula.

22. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 5, wherein, in the above formula (1), X and Y together express a carbonyl group in cooperation with the carbon atom to which they are bonded.

23. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 6, wherein, in the above formula (1), R<sub>41</sub> and R<sub>42</sub> are both hydrogen atoms or together express a methylene group.

24. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 6, wherein, in the above formula (1), R<sub>43</sub> and R<sub>44</sub> are both hydrogen atoms or together express a methylene group.

25. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 6, wherein, in the above formula (1), R<sub>45</sub> and R<sub>46</sub> are both hydrogen atoms.

26. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 6, wherein, in the above formula (1), D and E are both hydrogen atoms, D and E together express a single bond and form a double bond in cooperation with the single bond already shown in the formula, or D is a hydrogen atom and E and R<sub>41</sub> together express a single bond and express a double bond in cooperation with the single bond already shown in the formula.

27. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>51</sub> is -CONR<sub>511</sub>R<sub>512</sub> or -COR<sub>513</sub>.

28. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>51</sub> is -CONR<sub>511</sub>R<sub>512</sub>

29. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>51</sub> is -COR<sub>513</sub>.

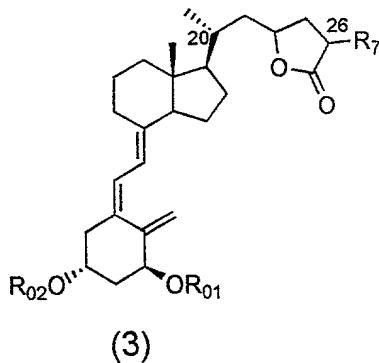
30. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>51</sub> is -CONR<sub>511</sub>R<sub>512</sub>, and R<sub>511</sub> and R<sub>512</sub> are identical to or different from each other, and they are a methyl group or an ethyl group, or both the members together

express an aziridine, pyrrolidine, piperidine or morpholino ring in cooperation with the nitrogen atom to which they are bonded.

31. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>51</sub> is 5 -COR<sub>513</sub>, and R<sub>513</sub> is a methyl group or an ethyl group.

32. A vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in Claim 7, wherein, in the above formula (1), R<sub>52</sub> is a methyl group.

33. A treating agent for an inflammatory respiratory disease 10 containing a therapeutically effective amount of a vitamin D<sub>3</sub> derivative described by the following general formula (3) or pharmaceutically permissible solvate thereof,



15

~ (in the formula, R<sub>01</sub>, R<sub>02</sub> and R<sub>7</sub> are defined in the same manner as in the above formula (2)).

34. A treating agent for an inflammatory respiratory disease containing a therapeutically effective amount of a vitamin D<sub>3</sub> derivative or a 20 pharmaceutically permissible solvate thereof described by one out of Claims 1 to 32.

35. A treating agent for an inflammatory respiratory disease described in Claim 33 or 34, wherein the inflammatory respiratory disease is one or not less than two kinds of inflammatory respiratory diseases selected 25 from a group consisting of acute upper airway infection, chronic sinusitis, allergic rhinitis, chronic lower airway infection, pulmonary emphysema, pneumonia, bronchial asthma, tuberculosis sequela, acute respiratory

distress syndrome, cystic fibrosis and pulmonary fibrosis.

36. A treating agent for an inflammatory respiratory disease described in Claim 35, wherein the acute upper airway infection is one or not less than two kinds of diseases selected from a group consisting of common cold, acute pharyngitis, acute rhinitis, acute sinusitis, acute tonsillitis, acute pharyngitis, acute epiglottitis and acute bronchitis.

37. A treating agent for an inflammatory respiratory disease described in Claim 35, wherein the chronic lower airway infection is one or not less than two kinds of diseases selected from a group consisting of chronic bronchitis, diffuse panbronchiolitis and bronchiectasis.

38. A treating agent for one or not less than two kinds of inflammatory respiratory diseases selected from a group consisting of chronic bronchitis, diffuse panbronchiolitis, bronchiectasis, bronchial asthma, pulmonary emphysema, tuberculosis sequela and cystic fibrosis which contains a therapeutically effective amount of a vitamin D<sub>3</sub> derivative or pharmaceutically permissible solvate thereof described in one out of Claims 1 to 32.

39. A treating agent for a disease selected from a group consisting of malignant tumors, rheumatoid arthritis, osteoporosis, diabetes mellitus, hypertension, alopecia, acne, psoriasis and dermatitis which contains a therapeutically effective amount of a vitamin D<sub>3</sub> derivative or pharmaceutically permissible solvate thereof described in one out of Claims 1 to 32.

40. A compound having vitamin D<sub>3</sub> antagonistic effect which is a vitamin D<sub>3</sub> derivative or a pharmaceutically permissible solvate thereof described in one out of Claims 2, 4 to 11, and 14 to 32.

41. A treating agent for hypercalcemia attributable to vitamin D excess which contains a therapeutically effective amount of a compound described in Claim 40.

42. A treating agent for hypoparathyroidism which contains a therapeutically effective amount of a compound described in Claim 40.

43. A treating agent for metabolic disorder of cartilage which contains a therapeutically effective amount of a compound described in Claim 40.

44. A pharmaceutical composition composed of a vitamin D<sub>3</sub> derivative or pharmaceutically permissible solvate thereof described in one out of Claims 1 to 32, and a pharmaceutically permissible carrier.